126 - FOR.101

A.D. 1913. JAN. 21. No. 1678.
NEEDHAM & *another's* COMPLETE SPECIFICATION.

(3 sheets)

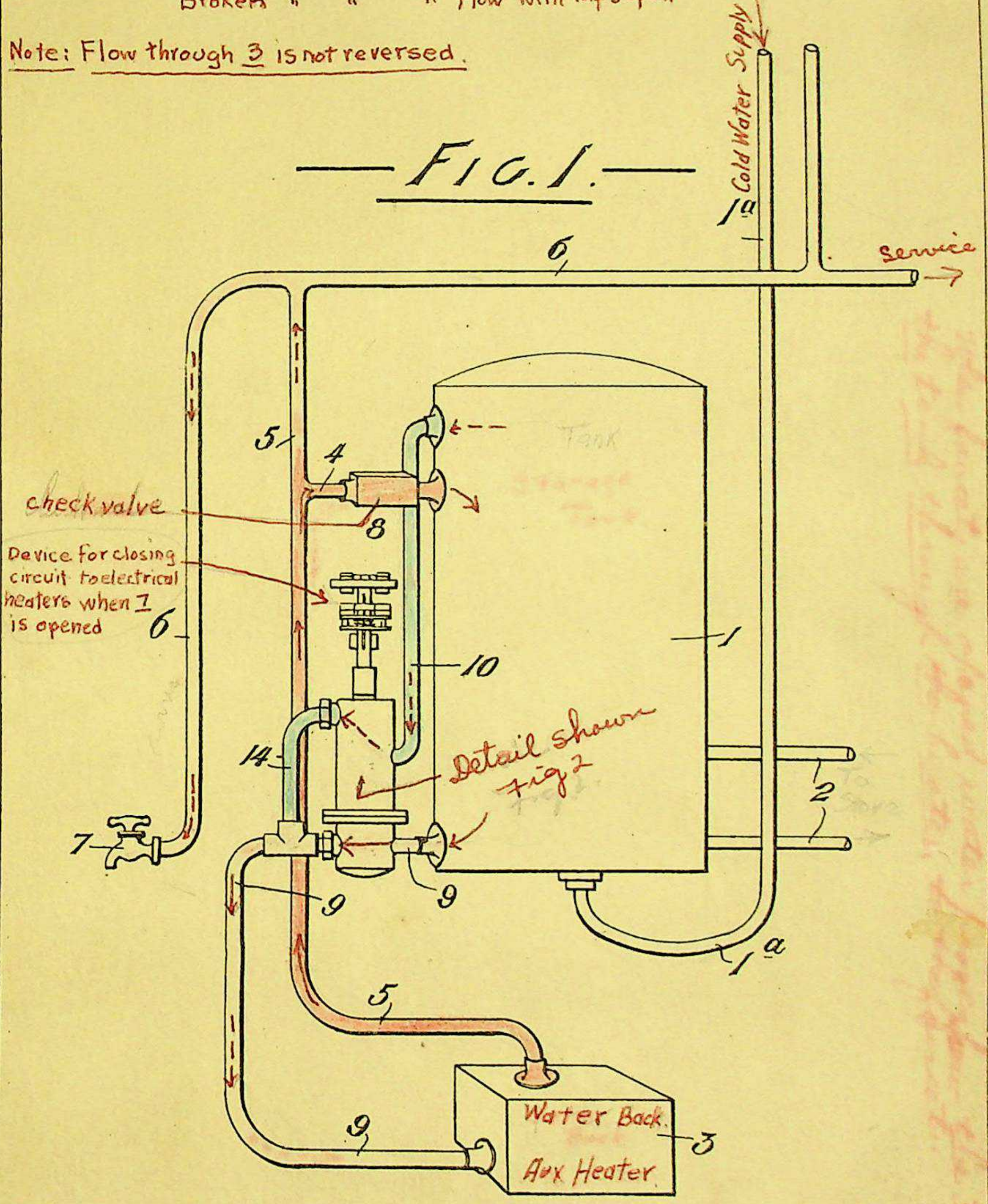
SHEET 1.

7 pages Spec.

Full line arrows show Normal Flow (No taps open)
Broken " " " flow with taps open

Note: Flow through 3 is not reversed.

FIG. 1.



3 may be electrically heated (See Figs. 5 & 6)

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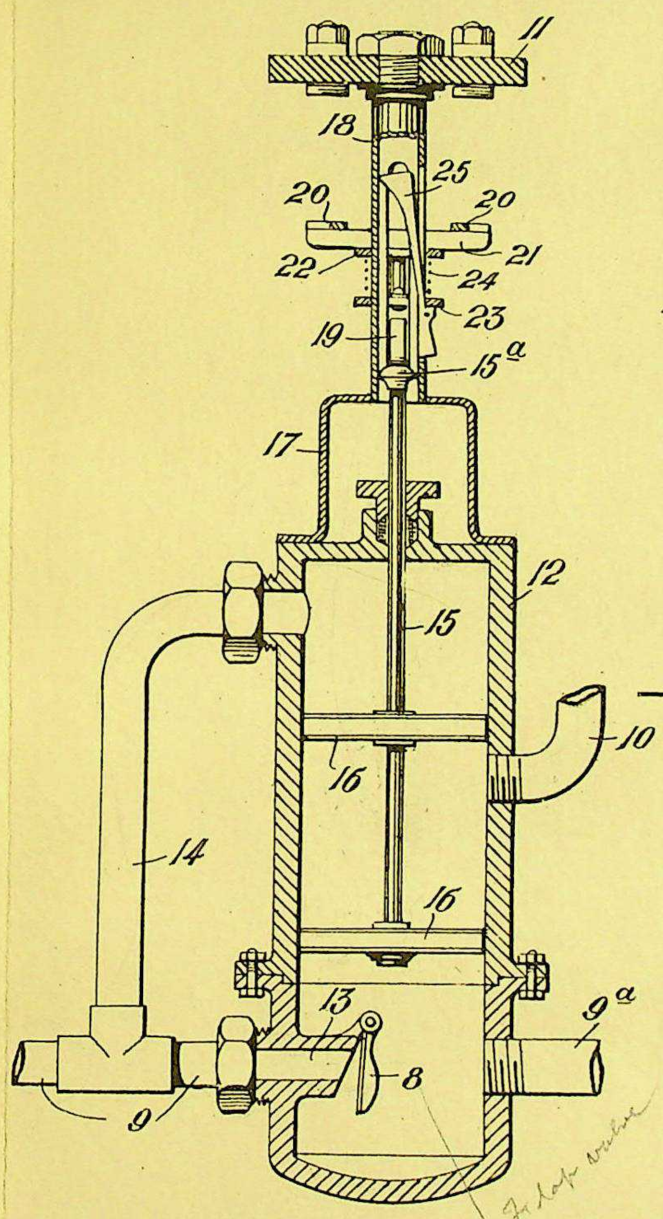
(3 SHEETS)

SHEET 2.

1675 of 1913

FIG. 2.



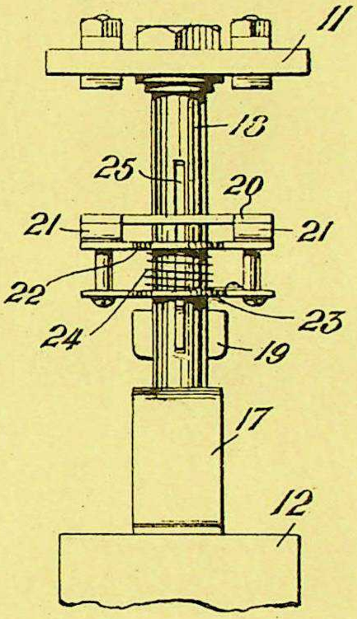


FIG. 3.

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(3 SHEETS)
SHEET 3.

1678/1913

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FIG. 4.

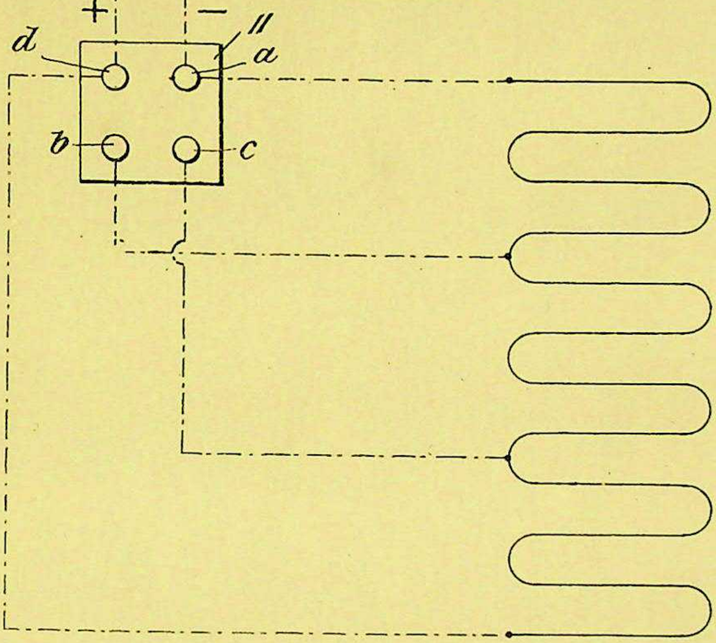

FIG. 5.

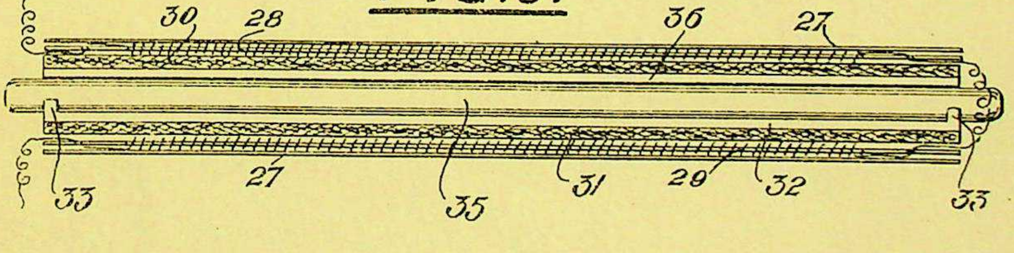

FIG. 6.

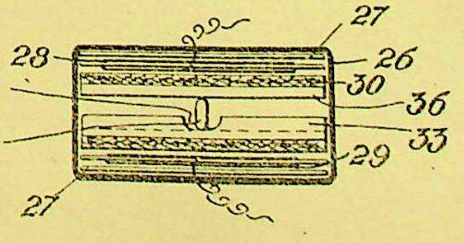

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FIG. 1.

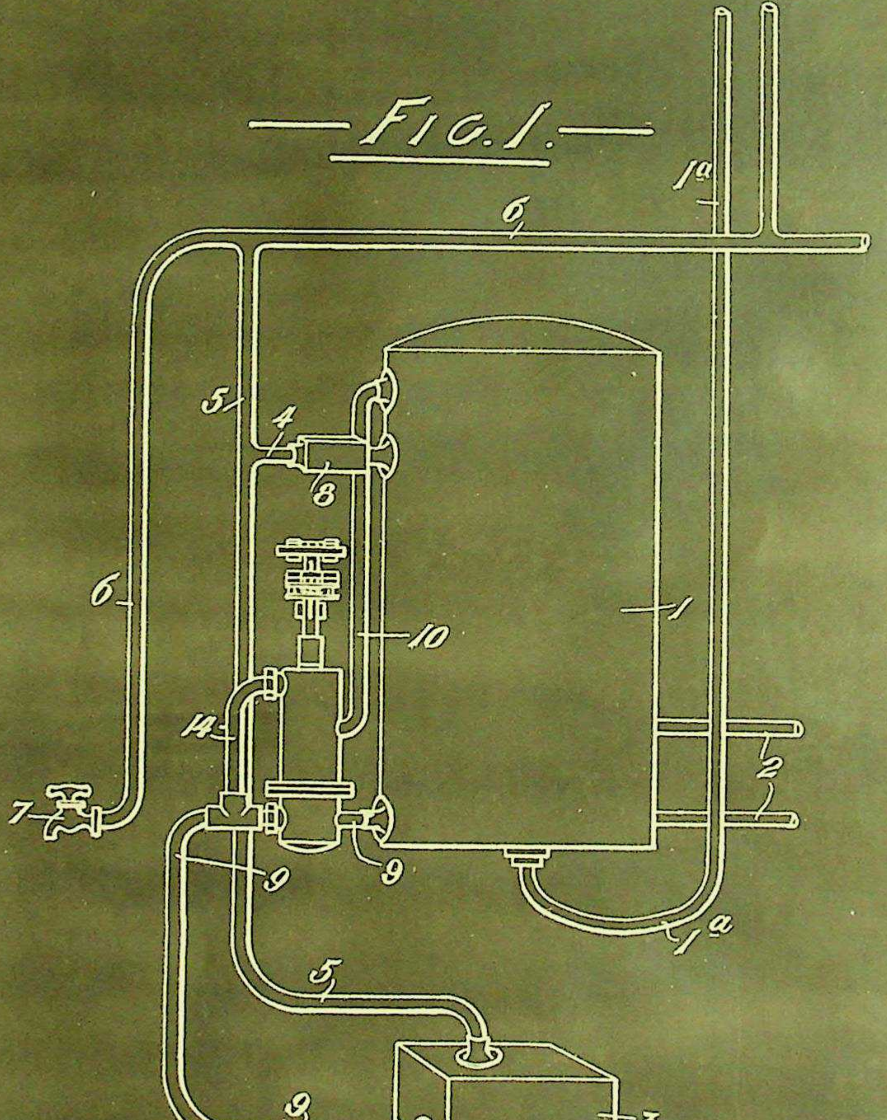
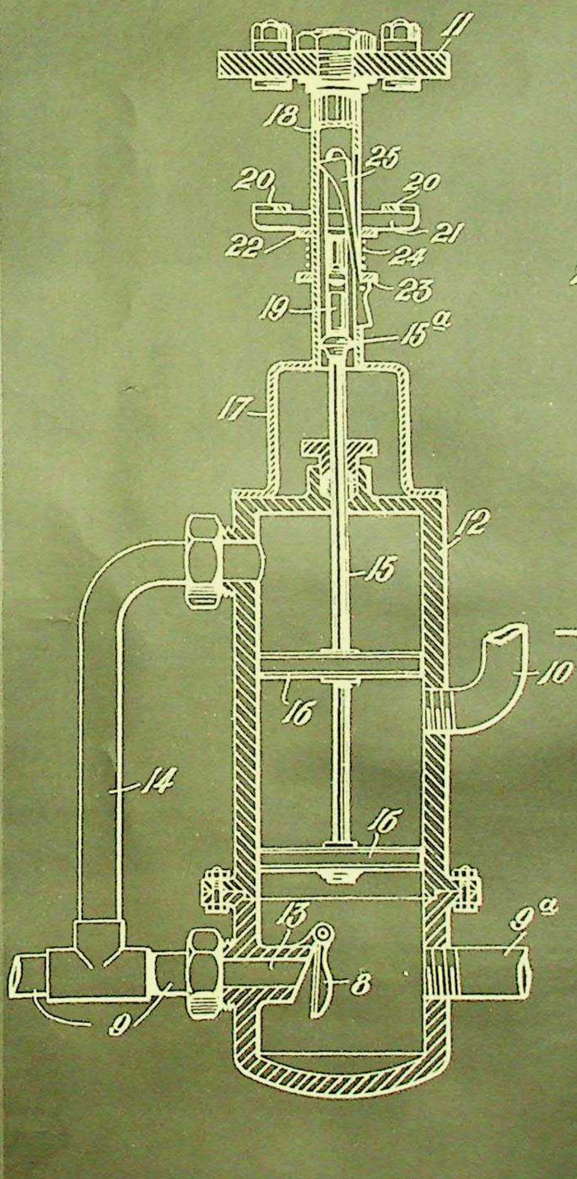


FIG. 2.



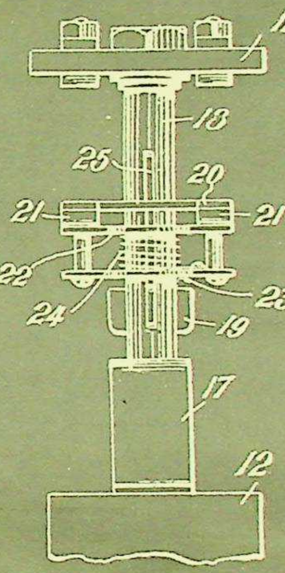


FIG. 3.

19

Nº 1678 A.D. 1913

Date of Application, 21st Jan., 1913

Complete Specification Left, 21st July, 1913—Accepted, 21st Jan., 1914

PROVISIONAL SPECIFICATION.

Improvements in or connected with Apparatus for Heating Water.

We, Victor Storer Needham, of 5, The Hermitage, Richmond, in the County of Surrey, Electrical Engineer, and Frederick George Needham, of 48, Brodrick Road, Upper Tooting, in the County of London, Engineer, do hereby declare the nature of this invention to be as follows:—

This invention relates to apparatus for heating water, and it is especially applicable for use with domestic hot water supplies.

It is usual in heating water and in storing such water in household hot water supplies, to employ a heating apparatus such for instance as a boiler in the kitchen fireplace, and to connect such boiler by circulating flow and return pipes to upper and lower levels in a hot water storage tank. The storage tank has a pipe connection attached to its upper end, from which the hot water used in the house is drawn, and the cold water supply to the storage tank is connected to the base of the same.

The well known phenomenon of the heated water rising to and remaining at the top of the storage tank and the cold water remaining in the bottom of the same, ensures that the hottest water in the storage tank is drawn off as required.

In such a system, during the period when the hot water is being drawn off the boiler or other heating apparatus continues its action of supplying heated water to the upper portion of the tank, but not increasing the heat of the water actually drawn off, and the object of this invention is to provide means whereby when hot water is being drawn off, the heat of the boiler or of an auxiliary heating apparatus, may be utilised not simply for supplying heated water to the storage tank, but for increasing the heat of the water being drawn off from the upper part of such tank.

The invention further relates to automatic means for turning on greater heat to the boiler, or to an auxiliary heating apparatus when such is employed, when heat is required for the purpose of increasing the heat of the water flowing from the upper portion of the tank to the place where it is used, this application of extra heat being specially convenient when electricity, gas or oil is employed as an auxiliary heating medium.

An example of apparatus arranged and constructed in accordance with this invention, consists of a storage tank communicating with a water heating apparatus, with which it is connected by means of a flow pipe attached to the upper part of the heater and communicating with the upper portion of the storage tank, and a return pipe connecting the lower portion of the storage tank with the lower portion of the heater. The connections between the flow pipe and the storage tank and the return pipe and the storage tank are by way of check valves, which permit the flow to take place slowly in proportion to the speed of the water circulation, but which automatically close when the speed of flow increases, such as occurs when water is drawn off at a tap. The flow pipe also communicates with the supply pipe to the hot water taps in the house, and

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FIG. 4.

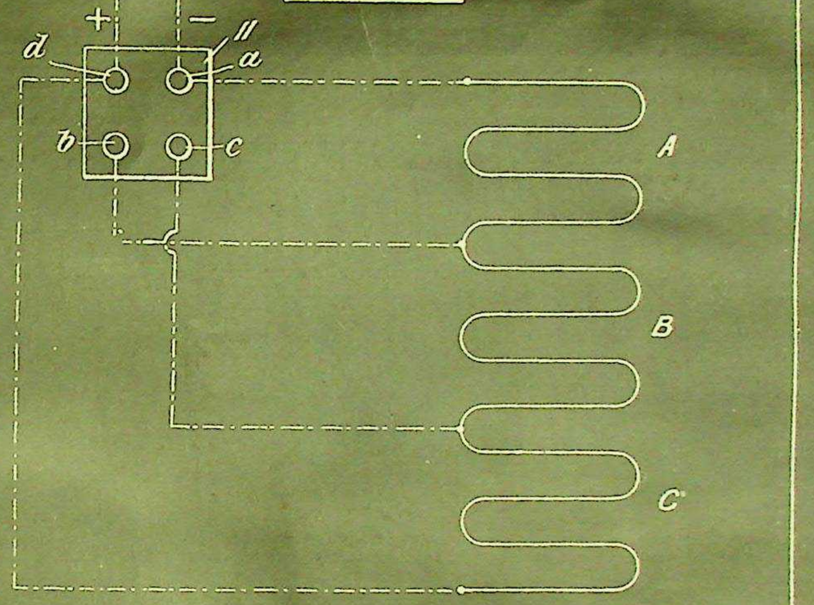


FIG. 5.

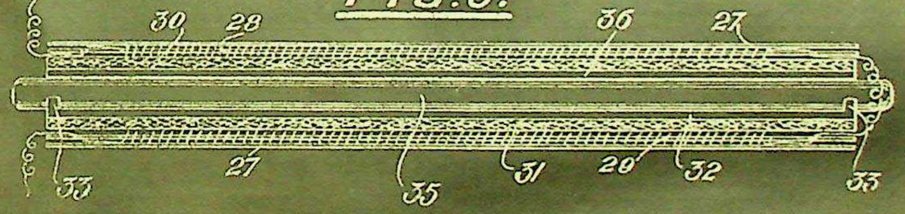
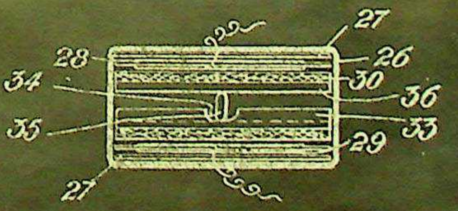


FIG. 6.



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the return pipe has a branch which communicates with the upper portion of the storage tank.

The effect of this construction is that when hot water is not being drawn off at any of the hot water taps, the circulation of the heater supplies heated water through the flow pipe to the upper portion of the storage tank, and it receives its supply from the lower portion of the storage tank by way of the return pipe, but immediately water is drawn off at one of the hot water taps, the speed of flow through the heater increases and the check valve to the return pipe communicating with the base of the storage tank becomes closed, thus forcing the heater to draw its supply from the branch communicating with the upper portion of the storage tank. The increased flow also closes the check valve communicating between the flow pipe and the upper portion of the storage tank, and consequently the flow from the heater travels to the supply pipe communicating with the hot water taps instead of passing to the storage tank.

In this way the water drawn off at the hot water taps is drawn from the upper portion of the storage tank containing the water at the greatest heat, and that water before reaching the hot water taps is obliged to pass through the heater and so become superheated before arriving at the tap where the hot water is being drawn.

The movement of one of the check valves or of an auxiliary vane or pressure-actuated part in the hot water circuit, may be employed to operate a switch, which, by means of a relay, if the power of such switch is insufficient, may be caused to switch in additional heating elements or burners, so as to increase the heat imparted by the heater during the period of flow of hot water to the hot water tap.

The heater referred to in the foregoing examples of construction may suitably be an auxiliary heater which imparts additional heat to the hot water storage tank, and which is used for superheating the hot water supply when hot water is being drawn off at one of the hot water taps, but the main heat imparted to the storage tank may be conveyed by an ordinary circulation, consisting of the usual flow and return pipe communicating with a kitchen boiler or other furnace.

It is obvious that the heater which is used for superheating the hot water supply passing to the hot water tap, may be either separate from the said storage tank, or may be attached thereto, or be contained therein and so enable the apparatus to be constructed as a self-contained unit. In some cases the heater may be entirely separated from the storage tank and may be situated in connection with the pipe leading to the hot water taps. In such case a check valve or other operated part which moves on hot water flowing to the hot water taps, would switch on the electric or gas heat to the heater, and such heater would then be employed as a superheater only and not for supplying heat to the water contained in the storage tank.

Dated this 21st day of January, 1913.

BREWER & SON,
33, Chancery Lane, London, and
7, East Parade, Leeds,
Patent Agents for the Applicants.

COMPLETE SPECIFICATION.

Improvements in or connected with Apparatus for Heating Water.

We, Victor Storer Needham, of 5, The Hermitage, Richmond, in the County of Surrey, Electrical Engineer, and Frederick George Needham, of 48, Brodrick Road, Upper Tooting, in the County of London, Engineer, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to apparatus for heating water for use with domestic hot water supply systems in which the water heating boiler is arranged at a distance from the hot water storage tank

It is usual in heating water and in storing such water in household hot water supplies, to employ a heating apparatus such for instance as a boiler in the kitchen fireplace, and to connect such boiler by circulating flow and return pipes to upper and lower levels in a hot water storage tank. The hot water tank has a pipe connection attached to its upper end, from which the hot water used in the house is drawn, and the cold water supply to the hot water tank is connected to the base of the same.

The well known phenomenon of the heated water rising to and remaining at the top of the hot water tank and the cold water remaining in the bottom of the same, ensures that the hottest water in the hot water tank is drawn off as required.

In such a system, during the period when the hot water is being drawn off, the boiler or other heating apparatus continues its action of supplying heated water to the upper portion of the tank, but not increasing the heat of the water actually drawn off, and the object of this present invention is in a system in which hot water is supplied to the storage tank from a boiler at a distance from said tank, to provide improved means whereby when the water is being drawn from the hot water system, the water being thus drawn is automatically caused to flow from the hot water tank directly into the boiler by which the water is heated, prior to entering the tank, or into an auxiliary heating device, and from thence into hot water service pipes provided with the hot water taps, thus increasing the temperature of the water to above that at which it leaves the hot water tank.

The invention further relates to means automatically operated, upon drawing hot water, for increasing the heat imparted to the boiler or to the auxiliary heating device; this application of extra heat is especially convenient when electricity, gas or oil is employed as an auxiliary heating medium.

It has already been proposed in apparatus for heating water, to provide a tank with a central vertical heating chamber containing a coiled pipe which communicates at its opposite ends with the interior of the top and bottom of the tank, the central chamber and coil being heated by burners below said coil.

Until water is drawn from the bottom of the tank, the water circulates from the bottom of the tank through the coil to the top of the tank; as soon however as water is drawn from the tank, the supply of water to the lower end of the coil is stopped by an automatically operating valve, the water being then drawn from the top of the tank down through the heated coiled pipe and away through the delivery pipe which communicates with the lower end of the coil, through a water box in the bottom of the said tank, the inlet of water from the tank to the box being provided with the automatically operating valve.

The present invention will be fully described with reference to the accompanying drawings, in which,

Fig. 1 is a diagrammatic view of a hot water system employing apparatus according to this invention.

Fig. 2 is a vertical section of a detail.

Fig. 3 is an elevation of the upper end of Fig. 2 looking towards the left hand.

Fig. 4 shows diagrammatically an arrangement of connections for electric heaters.

Fig. 5 is a longitudinal section of a preferred form of electric heater, and

Fig. 6 is an end view of the heater shown in Fig. 5 in position in a boiler tube.

Referring to Fig. 1, 1 is the hot water storage tank which is supplied with cold water by means of a pipe 1^a, and which tank is connected by means of circulating pipes 2 with a boiler heated by a stove in the usual manner. 3 is what is hereafter referred to as an auxiliary heater, and consists of a boiler heated in any suitable manner, through which boiler water from the hot water tank 1 normally flows to circulate through said tank. The said heater may take the place of the ordinary circulating boiler.

The hot water tank 1 is connected through a branch pipe 4 with a pipe 5, one end of which latter pipe is connected to the auxiliary heater 3, while its other end is connected to the hot water service pipe 6, which latter is provided with taps 7 where required.

The branch pipe 4 is provided with a check valve, such for instance as a flap valve as is shown at 8, Fig. 2, the said valve permitting water to freely circulate from the upper part of the auxiliary heater 3 into the upper part of the tank 1, but acting to prevent the water flowing through the branch pipe 4 in the reverse direction when the service pipe is in use.

A return pipe 9 connects the lower part of the tank 1 with the lower part of the auxiliary heater 3, and this pipe, like the branch pipe 4, is provided with a check valve 8 which allows circulating water to flow from the lower part of the tank 1 through the return pipe 9 of the lower part of the auxiliary heater 3, but as soon as the speed of flow of water through the return pipe 9 exceeds the speed of flow of water during the circulation from the tank 1 to the auxiliary heater 3, the valve operates to prevent water from the lower part of the tank 1 flowing through the return pipe 9.

The return pipe 9 is however connected by means of a pipe 10 either directly or through a device, as shown in detail in Fig. 2 and indicated diagrammatically in Fig. 1, with the tank 1 in such a manner that the check valve 8 cannot prevent the flow of water through the pipe 10, and that portion of the return pipe 9, between the check valve and the auxiliary heater 3.

By the arrangement so far described, it will be seen that, presuming none of the taps 7 are opened in the hot water service pipes, the water from the tank 1 flows gently from the lower part of the said tank through the return pipe 9 past the check valve 8 therein, to the lower part of the auxiliary heater 3, which latter is subjected to the desired degree of heat. From the heater 3 the water flows through the pipe 5 and branch pipe 4 past the check valve therein into the upper end of the tank 1, thus a circulation of water is maintained through the tank 1 and the auxiliary heater 3.

Upon opening one or more of the taps 7 a sudden increase of flow of water takes place in the pipe 5 from the top of the auxiliary heater 3, and also through the pipe 9 supplying the said auxiliary heater. This sudden increase in the flow of the water reduces the pressure of water in the branch pipe 4, causing the check valve 8 therein to operate to prevent water from flowing through the said branch pipe 4 from the tank 1, and also causes the check valve in the return pipe 9 to prevent water from the lower end of the said tank passing through that portion of the return pipe 9 located between the check valve and the tank. The water thus flows from the upper part of the tank 1 through the pipe 10 into that portion of the pipe 9 between the check valve and the auxiliary heater 3 through the said return pipe 9 into the lower end of the heater 3 to become superheated therein, and which water leaves the heater by the pipe 5 and enters the service pipe 6 from which it is withdrawn in a superheated condition.

As soon as the taps 7 are closed the check valves automatically open the passages through the branch pipe 4 and the return pipe 9 to and from the tank, and the ordinary circulation as before described is again established.

It is preferred to employ auxiliary heating means to supply additional heat to the auxiliary heater during the time that water is being drawn from the service pipe 6, and such auxiliary heating means may be of any suitable form adapted to be automatically brought into action upon the taps 7 being turned on, and such means may consist in the provision of a multiplicity of gas burners, a proportion of which are always alight, while when, the water is being drawn, the remainder are lighted, or the flame from the gas burners may be increased upon drawing water. Obviously other means may be employed for this purpose.

In Fig. 4 we have diagrammatically shown a system for heating the auxiliary heater by means of electric heaters, which we have found to be highly satisfactory, and it consists of three electric resistances A, B and C, each of which forms a separate heating element, the opposite ends of these resistances are connected through leads to contact studs *a*, *b*, *c* and *d* provided on a stationary insulated plate 11 and so arranged that normally the electric current from the positive main, which is connected to the contact stud *d*, passes in series through the separate resistances and leaves by the contact stud *a*, whereas by bridging across the contact studs *d*, *b* and *a*, *c*, the resistances are placed in parallel across the mains, thus increasing the heating effect thereof.

In Fig. 2 a device is shown whereby the bridging of the contacts *d*, *b* and *a*, *c* is automatically effected upon the hot water being drawn from the hot water service pipe 6. The device comprises a vertically arranged cylinder 12, the lower end of which is detachably connected to the main portion of the cylinder, and into one side of which lower end there passes a pipe 9^a communicating with the lower part of the tank 1, while extending from the other side of the said lower end of the cylinder and in alignment with the pipe 9^a the return pipe 9 is connected so as to form a continuation of a passage 13 which extends into the cylinder, the inner end of which passage 13 is adapted to be closed in the manner described, by means of the check valve 8.

Connecting the upper end of the cylinder 12 to the return pipe 9 is a branch pipe 14, while the pipe 10 connected to and entering the upper end of the tank 1, at its lower end enters the cylinder 12 at a suitable distance from the upper end thereof. Passing through a stuffing box in the top wall of the cylinder 12 is a rod 15 provided within the cylinder with two pistons 16, said pistons being so distanced apart that when they are in their lowest position, as shown in Fig. 2, water from the pipe 10 cannot pass through the cylinder 12, but when the pistons are raised in the manner to be described, water from the pipe 10 flows through that part of the cylinder enclosed between the two pistons 16, into the branch pipe 14 and from thence into the return pipe 9 and to the auxiliary heater 3.

Supported above the upper end of the cylinder 12, by means of a frame 17, is a vertical tube 18, into which tube the upper end of the piston rod 15 passes, and in slots in the opposite sides of this tube 18 and extending beyond the exterior of the tube there slides a cross piece 19 on the upper end of the piston rod 15, the tube at the lower ends of the slots limiting the downward movement of the piston rod 15 by the cross piece 19 contacting therewith.

To the upper end of the tube 18 is fixed the contact plate 11, previously described with reference to Fig. 4, while slidable but nonrotatable on the tube 18 is a frame provided with two contact bars 20 adapted to bridge across the contacts *d*, *b* and *a*, *c* when the frame is raised. The contact bars are supported at opposite ends on strips 21 of insulating material, which strips are fixed to arms extending from a ring 22 surrounding and slidable on the tube 18, and slidable upon the tube 18 and on pins depending from the arms of the ring 22 is a second ring 23, said rings 22 and 23 being resiliently held apart by means of a helical spring 24, the pins on the ring 23 limiting the extent of movement apart of the said two rings.

The lower ring 23 is, upon the rise of the piston 15, raised upon the tube 18 by the cross piece 19 of the piston contacting therewith, and consequently the ring 22 together with the contact bars 20, is raised to make electric connection with the contacts *d*, *b* and *a*, *c* on the plate 11, and upon the further rise of the piston rod 15 the said contacts are resiliently held in position.

In order to retain the contact bars 20 in their raised position until the piston has reached the extent of its downward movement, there is pivoted, in a vertical slot in the tube 18, a two-armed lever 25, the upper end of which is formed with a projection which normally extends into the tube, while the lower end of the lever is formed with a ledge exterior of the tube, upon which ledge normally rests the lower ring 23 of the contact frame.

When the piston rod 15 reaches the extent of its upward movement, the cross piece 19 thereon forces the upper end of the lever 25 in an outward direction, thus causing it to engage the under-surface of the ring 23 and resiliently support the contact bars 20 so that the desired electric connection is made.

Upon the descent of the piston rod 15, the lower end of the lever, which during the upward movement of the said rod has been caused to project within the tube 18, is at or near the end of the downward movement of the piston rod 15 operated upon by a projection or collar 15^a on the piston rod 15 so as to return the lever 25 to its original position and cause the upper end of the said lever to disengage the ring 23 of the contact frame and allow the contact bars to fall by gravity.

With this arrangement it will be seen that when the hot water service is in use, the valve 8 closes the entrance to the passage 13, and the force of water under the lower piston 16 raises the piston and the rod 15 carrying the same, and through the mechanism just described places the resistances of the electric heaters in parallel to apply extra heat to the auxiliary heaters 3, and at the same time opens communication between the pipe 10 and the branch pipe 14 through the cylinder 12, and thus hot water flows from the upper part of the tank 1 directly into the auxiliary heater 3, while when the use of the hot water service is discontinued the valve 8 automatically returns to its normal position, and the pistons 16 together with the rod 15 fall by gravity and rock the lever 25 so as to release the contact bar carrying frame, which then falls to its normal position to again place the electric resistances in series.

A convenient construction of electric heater is shown in Figs. 5 and 6 of the accompanying drawings, and which heater is adapted to be placed into tubes of rectangular cross section extending through the boiler or auxiliary water heater, one of which tubes is shown in section at 26, Fig. 6. The said heater comprises an upper and a lower strip 27 of insulating material such as mica, an upper resistance 28 and a lower resistance 29 formed of wire of low electric conductivity coiled round insulating strips of mica or like material, and connected in series, the upper resistance 28 lying on a sheet of asbestos 30, while upon the lower resistance 29 is placed a similar sheet 31 of asbestos.

At the centre of the heater are two plates of metal, such as steel, of a width and length corresponding to that of the other elements of the heater, and the ends of the lower metal plate 32 are upturned, as at 33, and are formed with recesses 34 in which a rod 35 of oval or elliptical cross section is supported, which rod 35, when turned so that its major axis is parallel with the metal plates, it allows the upper plate 36 to rest upon the upper surfaces of the upturned ends 33 of the lower plate 32, in which position the said heater can readily be inserted into the tube 26, and when in position the rod 35 is given a quarter of a turn, so that it assumes the position shown in the drawings, to distance the plates 32 and 36 and thus clamp the heater firmly within the tube 26 so that the upper and lower mica strips 27 press upon the upper and lower walls of the said tube. Several heaters so constructed may be electrically connected and operated in the manner described with reference to Fig. 4.

If found desirable, instead of providing a switch to automatically place electric heaters, which are normally in series, in parallel to increase the heating effect thereof, a switch may be employed by means of which more heaters than those normally employed are switched in when an increased heat is required, such arrangement will be obviously to those acquainted with the art.

Although check valves of the flap valve type have been described, obviously any other suitable form of valve which performs the desired function may be employed.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. In apparatus for heating water comprising a hot water storage tank supplied with hot water by a boiler distant from said tank; means, automatically operated upon drawing water from the hot water system, to cause hot water from the upper end of the hot water storage tank to flow directly into the water heating boiler or an auxiliary water heater, situated at a distance from said tank, and from thence to the hot water service pipe, substantially as described.

2. In apparatus for heating water as claimed in Claim 1; means, brought automatically into operation, to impart additional heat to the boiler or the auxiliary water heater when drawing water from the hot water system.

3. In apparatus for heating water as claimed in Claim 1; a pipe connecting the upper part of the boiler or auxiliary water heater directly to the hot water service pipe said connecting pipe having a branch communicating with the upper part of the hot water storage tank said branch being provided with a check valve to prevent water flowing through said branch into said hot water service pipe, but to allow of the free circulation between the upper part of the hot water tank and the boiler or auxiliary water heater when the service pipe is not in use, a return pipe connecting the lower part of said tank to the lower part of the boiler or auxiliary water heater said return pipe being provided with a check valve to prevent water flowing beyond a predetermined rate from the said lower part of said tank into said boiler or auxiliary heater and a second pipe connecting said return pipe to the upper part of said tank through which second pipe water flows from said upper part of said tank into the return pipe and from thence to the boiler or auxiliary water heater when said check valve is closed, substantially as described.

4. In apparatus for heating water as claimed in Claim 2, and in which the boiler or auxiliary heater is heated by electric heaters; a switch automatically operated upon water being drawn from the hot water system to insert further heating elements into the electric circuit to increase the heat imparted to the said boiler or auxiliary heater.

5. Apparatus for heating water constructed and operating as hereinbefore described with reference to the accompanying drawings.

Dated this 21st day of July, 1913.

BREWER & SON,
33, Chancery Lane, London, and
7, East Parade, Leeds,
Patent Agents for the Applicants.

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